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EDITORIAL

Research and the Plight of Teachers of Operative Dentistry

Research in operative dentistry is not commensurate with either the scope of the discipline or the number of faculty engaged in teaching it. As evidence, operative dentistry does not even appear in the list of subjects categorized by the International Association for Dental Research though restorative dentistry does and dental materials and prosthodontics are both accorded the higher status of groups. Although transmitting and discovering knowledge are the two main obligations of teachers, many in operative dentistry do not, for a number of reasons, engage in any research. This is unfortunate because research sharpens the intellect and maintains enthusiasm for the subject, both of which redound to the advantage of the student and the profession.

Universities have recently begun to demand more tangible results of scholarly activity from their faculties. Failure to comply has resulted in postponement of promotions and of raises in salary, and even to dismissals. Consequently good clinicians—a scarce resource at any time—are being lost from the teaching profession or discouraged from entering it. This, too, is unfortunate because we need good clinicians as teachers if our students are to attain a high level of competence.

The difficulties of research stem not only from the skills required in its pursuit but also from the facilities, equipment, money, and time that are needed. Teachers of operative dentistry must spend a relatively large part of their time teaching in the clinic and their schedules are often such that a suitable block of time for research is not easy to obtain. To compound the difficulty seldom is any help or guidance available for the beginner, who usually needs some initial direction and encouragement. This is because research is more difficult than teaching. Were it not so more teachers would be engaged in research. As it is, much research related to operative dentistry is undertaken by scientists in departments of dental materials.

In these circumstances dental schools, and departments of operative dentistry in particular, should reassess their policies with a view to augmenting the support for research and thus enhancing their programs by bringing teaching and research into better balance. One way to encourage faculty to undertake research would be to allow them to work for higher degrees without having to remain at the lowest academic rank while doing so, as at present. There are a few graduate programs in operative dentistry that lead to a master’s degree, but the time available for research is all too limited. Naturally a student in such a program is anxious to complete it as soon as possible and tends to look for a research project that is conveniently short rather than challenging. What we need is a program that would recognize a sustained effort over a longer period that results in discoveries of some significance. What better way to encourage the pursuit of research than to offer master’s and doctor’s degrees to the faculty on completing research projects of some consequence, even while holding the rank of professor or the title of department chairman? Such an arrangement would allow teachers to tackle more intractable problems. It might be argued that a system of this kind could lead to favoritism but this could easily be obviated by appointing an examiner from another university. The system has long been used successfully by British universities. Why not adopt this sensible and tested arrangement?

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**ORIGINAL ARTICLES**

\( \gamma_2 \) Content of Dental Amalgam vs Marginal Deterioration

Reduction of the \( \gamma_2 \) content of amalgam restorations does not necessarily lessen the deterioration of their margins.

M M A VRIJHOEF

We know from clinical experience that fracture of the margins of amalgam restorations is one of the most frequently occurring failures under oral conditions. Several theories have been proposed to explain the deterioration of margins but it is beyond the scope of this article to deal extensively with these theories. It is important, however, to mention the so-called mercuroscopic theory of Jørgensen because this theory is mentioned frequently in the literature and in advertisements of manufacturers, especially since the introduction of the so-called non-\( \gamma_2 \) and reduced \( \gamma_2 \) amalgams. Before dealing with Jørgensen's theory it is worthwhile to summarize the most important elements of the microstructure of an amalgam of conventional composition.

During the hardening of the amalgam, the reaction of the alloy with mercury forms new products at the expense of the original particles of alloy. The main products of the reaction are the \( \gamma_1 \) phase (silver and mercury) and the \( \gamma_2 \) phase (mercury and tin). Some porosity is always present in the structure as well.

In his mercuroscopic theory Jørgensen has postulated that corrosion of the \( \gamma_2 \) phase is the cause of the so-called p-type of marginal fracture. Corrosion of the \( \gamma_2 \) phase releases mercury, which then reacts with remnants of the particles of the amalgam alloy forming the \( \gamma_1 \) and \( \gamma_2 \) phases. This process of corrosion is active at the interface of tooth and amalgam. The formation of these new phases of amalgam as well as porosity will cause a localized expansion resulting in an unsupported wedge at the margin of the restoration. The wedge is relatively weak: first, because of its geometry (the wedge is weaker the smaller the angle) and second, because of the microstructure at the margin (large amounts of \( \gamma_1 \) and \( \gamma_2 \) phases as well as porosity). After a time the margin fractures under the forces of mastication.

Recently some alloys have been introduced that form amalgams with margins of superior integrity. These amalgams are free of \( \gamma_2 \) phase. Related to this new generation of dental amalgams a statement often can be found such as: "Corrosion is the main cause of marginal fracture. The \( \gamma_2 \) phase is corrosion prone. The mercury liberated after corrosion of this phase causes mercuroscopic expansion, which is followed by marginal fracture. Thus elimination of the \( \gamma_2 \) phase from dental amalgam solves the problem of marginal fracture." I shall attempt to show that this statement is not correct.

The susceptibility to marginal deterioration of more than 20 commercial amalgams is displayed in the graph. This graph has been con-
structed from data published by several authors (references available on request). Experimental amalgams have been omitted. The higher the column the greater is the marginal breakdown. No scale is given because a strictly quantitative interpretation of these data is not possible. Differences in experimental methods among the investigators, batch differences, differences in the manipulation of amalgam, differences among groups of patients, and so on, all influence the results. It is clear, for instance, that Twentieth Century Micro Cut results in much more marginal fracture than does Dispersalloy, but problems arise if the heights of the columns are approximately equal. For example, we should be careful in comparing Twentieth Century Fine Cut with New True Dentalloy because differences between dentists, patients, and so forth, also play a part. Spheraloy and Tytin are displayed at several places in this figure because contradictory data were found in the literature. In the case of Spheraloy these differences might be caused by differences in batches. Most of the high-copper amalgams might be considered to be free of \( \gamma_2 \) phase. However, amalgams from Micro II and Optalloy II contain substantial amounts of \( \gamma_2 \) phase. At best these amalgams may be referred to as reduced \( \gamma_2 \). This graph clearly illustrates that some of the non-\( \gamma_2 \) amalgams belong to the group that best resists marginal fracture. However, some others, such as Sybraloy and Aristaloy CR, exhibit relatively large amounts of marginal fracture. Furthermore, Micro II and Optalloy II, which might be considered to be reduced \( \gamma_2 \) amalgams, do not exhibit superior marginal integrity.

As a provisional conclusion I should like to state that the problem of marginal fracture is not solved necessarily by either a non-\( \gamma_2 \) or a reduced \( \gamma_2 \) amalgam.

The question of the general practitioner remains: "Which amalgam alloy to choose as far as marginal deterioration is concerned?" The answer is not easy. First of all, the data in the graph have been obtained from relatively short-term investigations. Moreover, the acceptable amount of marginal fracture in the long run is unknown. I have already alluded to the difficulty of comparing the amalgams quantitatively because of batch differences, patient effects, and so on. Therefore, selecting a critical level of marginal fracture is more or less arbitrary. My choice is the height of the group containing New True Dentalloy, because there has been relatively good experience with this alloy in many university clinics throughout the world over a relatively long time. Therefore, for resistance to marginal fracture, the practitioner might select for instance New True Dentalloy, Cavex SF, Luxalloy, Dispersalloy, or an equivalent alloy.

(Accepted 6/19/78)
Smoothness of Composite Restorations Polished by Various Abrasives: A Comparison by Scanning Electron Microscopy

The structure of composite resin precludes a high polish; however, a finish can be attained most efficiently with silicon carbide disks.

CHARLES R STALEY • HUGH M KOPEL

Summary

The smoothness of the surfaces, and the surrounding enamel, of restorations of three composite resins, Adaptic, Concise, and Vytol, were evaluated from scanning electron micrographs after the restorations had been finished and polished with disks of aluminum oxide, zirconium silicate, or silicon carbide, as well as with points of aluminum oxide, white polystone, or abrasive-free disks. Disks of silicon carbide were used with and without lubricants—water, Vaseline, or K-Y jelly. The differences in the smoothness attained with the various abrasives were not great, but disks of silicon carbide were more efficient. Lubricants did not improve the surface of the composite but when used with an abrasive-free disk reduced the scratches in the enamel. There were no differences in the effects of the lubricants. A technique for finishing and polishing resin by use of disks of silicon carbide and abrasive-free disks is described.

INTRODUCTION

One of the goals of the conscientious clinician in placing and finishing a restoration of composite resin is achieving the smoothest surface possible. A rough surface can contribute to an aesthetic or a functional failure because of increased staining, recurrent caries, or discomfort to the patient. The smoothest possible surface is obtained when the material sets against a matrix strip, but the necessary recontouring of the restoration and dressing of the margins removes this smooth surface and leaves a much rougher one, regardless of the method of polishing. The ultimate surface of a composite restoration should be nonporous and extremely smooth, with a maximum amount of the hard particles of filler at the surface to resist abrasion. The method of finishing
the composite to achieve this ideal surface has been controversial. The purpose of this study is to evaluate, with a scanning electron microscope, the smoothness of three composite resin materials after finishing with silicon carbide disks, and to compare these results with those of finishing with several other types of abrasive and nonabrasive agent. The effects of three different lubricants used with silicon carbide disks are also reported.

PROBLEMS IN POLISHING COMPOSITES

The major reason the composite resins are so difficult to finish is that the resin matrix and the inorganic fillers differ in hardness and thus are not abraded uniformly with the usual techniques of polishing. The strength of the bond between filler and resin matrix is important too, since it must prevent the abrasive from dislodging the particles of filler against which it is being used during the polishing. To achieve a maximum gloss, the abrasive particle should be fine enough not to leave scratches greater than the wavelength of visible light.

Many instruments have been advocated for finishing restorations of composite resin and include burs (Johnson, Jordan & Lynn, 1971; Scott & Roydhouse, 1968; Gray & Gavin, 1975) diamond stones and green stones (Dennison & Craig, 1972), white Arkansas stones (Gray & Gavin, 1975; Dennison & Craig, 1972; Weitman & Eames, 1975), diamond disks (Chandler, Bowen & Paffenbarger, 1971), cuttle disks (Scott & Roydhouse, 1968; Gray & Gavin, 1975), sandpaper disks (Scott & Roydhouse, 1968), zirconium silicate disks (Kanter, Koski & Graham, 1976; McLundie & Murray, 1974), silicon carbide disks (Dennison & Craig, 1972; Lee, Swartz & Smith, 1969; Tolley, Dennison & O'Brien, 1977), abrasive rubber wheels (McLean & Short, 1969), emery or cerium oxide paste (Scott & Roydhouse, 1968), aluminum oxide slurry (Weitman & Eames, 1975), and abrasive-free disks (Eliason & others, 1976). Resin glazes have also been advocated to improve the surface finish of composite restorations (Kun & Pameijer, 1975; Heath & Wilson, 1976), but they are generally short-lived because of abrasion (Pameijer, 1975; Calatrava, Dennison & Charbeneau, 1976; Soelberg & others, 1977).

Regardless of the method advocated in finishing a composite resin restoration, most clinicians agree that the immediate results are only transitory. This is because continuous abrasion and staining of composite resin in service precludes the stability of a polished surface. Also, the particles of filler may be dislodged as a result of hydrolysis of the bonding agent. Then too, porosity of the composite, resulting primarily from the manipulation and placement of the material, contributes to the irregularity of the surface after finishing.

MATERIAL AND METHODS

The composite resins used in the study are listed in Table 1 and the abrasives used to polish the restorations in Table 2.

<table>
<thead>
<tr>
<th>Composite Resins</th>
<th>Manufacturer</th>
<th>Basic Resin</th>
<th>Filler Particles</th>
<th>Approximate Weight of Filler %</th>
<th>Hardness of Filler Mohs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adaptic</td>
<td>Johnson &amp; Johnson New Brunswick, NJ 08903, USA</td>
<td>bis-GMA</td>
<td>quartz</td>
<td>77.7</td>
<td>7</td>
</tr>
<tr>
<td>Concise</td>
<td>3M Co St Paul, MN 55101, USA</td>
<td>bis-GMA</td>
<td>quartz</td>
<td>77.0</td>
<td>7</td>
</tr>
<tr>
<td>Vytil</td>
<td>L D Caulk Co Milford, DE 19963, USA</td>
<td>bis-GMA</td>
<td>barium aluminum silicate glass + lithium aluminum silicate glass</td>
<td>80.0</td>
<td>5</td>
</tr>
</tbody>
</table>

*Table 1. Composite Resins*
Table 2. Polishing Agents

<table>
<thead>
<tr>
<th>Product</th>
<th>Manufacturer</th>
<th>Abrasive</th>
<th>Grit Size</th>
<th>Mohs Hardness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adalox, medium</td>
<td>E C Moore Co/Girard, Inc</td>
<td>aluminum oxide</td>
<td>220</td>
<td>9</td>
</tr>
<tr>
<td>Waterproof, medium</td>
<td>E C Moore Co/Girard, Inc</td>
<td>zirconium silicate</td>
<td>220</td>
<td>7.7</td>
</tr>
<tr>
<td>Waterproof, fine</td>
<td>E C Moore Co/Girard, Inc</td>
<td>silicon carbide</td>
<td>320</td>
<td>9.5</td>
</tr>
<tr>
<td>Waterroof, x-fine</td>
<td>E C Moore Co/Girard, Inc</td>
<td>silicon carbide</td>
<td>400</td>
<td>9.5</td>
</tr>
<tr>
<td>Waterroof, xx-fine</td>
<td>E C Moore Co/Girard, Inc</td>
<td>silicon carbide</td>
<td>600</td>
<td>9.5</td>
</tr>
<tr>
<td>Abrasive-free</td>
<td>E C Moore Co/Girard, Inc</td>
<td>aluminum oxide</td>
<td>300, 500</td>
<td>9</td>
</tr>
<tr>
<td>Sot-Lex, medium</td>
<td>3M Co, St Paul MN 55101, USA</td>
<td>treated silicone</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shofu disk</td>
<td>Shofu Dental Corp, Menlo Park, CA 94025, USA</td>
<td>sintered aluminum oxide</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Forty extracted teeth with intact facial enamel were used in the study. They were first cleaned with a paste of zirconium silicate. Standard class 5 cavities (approximately 3 mm x 5 mm) were prepared with a 35 carbide bur operated at high speed and the margins finished with a 558 finishing bur at slow speed. The preparations were etched with 37% phosphoric acid for 60 seconds, rinsed with distilled water, and blown dry. The composites, mixed according to manufacturers' directions, were placed in the cavities in small increments with a plastic instrument and overfilled by approximately 1/2 mm. Each cavity received a freshly mixed composite resin. All specimens were stored in distilled water for at least 48 hours before finishing. Etching the preparations and storing the samples in water minimizes the gaps caused by shrinkage and avoids fracture of the enamel at the margins during finishing (Asmussen & Jorgensen, 1972). Also, the microhardness of polymers increases after 48 hours (von Fraunhofer, 1971), which suggests that a better surface can be achieved if polishing is delayed. Moreover, polishing immediately may craze the surface or loosen the molecular bond between the resin and filler (Hayashi & others, 1974).

Each restoration was then carefully finished to the margins with at least one of the various types of disk. When the xx-fine (600 grit) silicon carbide disk was the final polishing agent, gross reduction was done with the fine (320 grit) silicon carbide disk. The abrasive-free disk was preceded by both fine and xx-fine silicon carbide disks. Several samples were polished with disks of different sizes of grit used dry or lubricated with water, Vaseline, or K-Y surgical jelly (Johnson and Johnson, New Brunswick, NJ 08903, USA).

After the restorations were polished the teeth were sectioned in uniform blocks (approximately 7 mm x 9 mm x 5 mm) and cleaned with distilled water and methanol. The specimens were then cemented to the metal sample holder with conductive carbon paint, and slowly dehydrated for at least three days. The samples were coated with gold-palladium to a thickness of approximately 100 Å in a vacuum evaporator. All specimens were then examined in the scanning electron microscope (Stereoscan s410, Cambridge Scientific Instruments Co Ltd, Cambridge, England), with an accelerating voltage of 10 KV, an aperture of 200, and a tilt angle of 35°. Photomicrographs were taken at magnifications of x500, x1000, x5000, and x10 000.

All samples were rated and assigned a number between 1 and 3 (fractions permitted) for
both the smoothness of the composite and the severity of enamel scratching.

Rating Scale for Composites
1 - extremely smooth surface with uniform texture; filler particles polished to the same level as the resin matrix
2 - moderately smooth surface with a generally uniform texture but appearing pebbled because filler and resin matrix are not polished to the same level
3 - rough surface with deep scratches and large and plentiful particles of filler protruding from the resin matrix; particles of filler may have been pulled out

Rating Scale for Enamel
1 - very few or no scratches
2 - light or moderate scratching
3 - deep or severe scratching

Photomicrographs of the restored surfaces taken at x500 and x1000 were presented randomly to six dentists to evaluate the smoothness of the surface of the restorations and the degree of scratching of enamel. The evaluators had no knowledge of which finishing instruments had been used. Sample photographs and a brief description of the rating scales were provided each evaluator to assist him during the evaluation. An average value was then calculated from the ratings of each evaluator.

RESULTS

The evaluation of the smoothness of the composite surface is presented in Table 3 and that of the scratching of enamel in Table 4. It is apparent that differences in the composition of materials are responsible for differences in surface texture.

Although not shown in our tables or figures, we found that the disks of rougher silicon carbide remove the gross excess of composite restoratives as effectively as a white polystone run at high speed (compare Fig 1 with Fig 2), and that the xx-fine silicon carbide disk smoothes and polishes the composite surface to almost a final finish (Fig 3).

The surface of Vytol was consistently smoother when finished with comparable silicon carbide disks than was that of Concise or Adaptec (Figs 3, 4, & 5). Most finishing disks or stones can abrade or scratch the surface of the approximating enamel (Figs 4 & 5 and Table 4), however, we were able to reduce the severity of the scratches by using the abrasive-free “fluffed

Table 3. Smoothness of the Composite

<table>
<thead>
<tr>
<th>Disk or Stone Used for Final Polishing</th>
<th>Adaptic dry</th>
<th>H₂O Vaseline</th>
<th>K-Y</th>
<th>Concise dry</th>
<th>H₂O Vaseline</th>
<th>K-Y</th>
<th>Vytol dry</th>
<th>H₂O Vaseline</th>
<th>K-Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adalox</td>
<td>3.0</td>
<td>2.7</td>
<td>1.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zirconium silicate</td>
<td>2.0</td>
<td>2.5</td>
<td>1.6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Silicon carbide fine</td>
<td>2.6</td>
<td>2.0</td>
<td>2.1</td>
<td>2.0</td>
<td>2.3</td>
<td>2.2</td>
<td>1.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Silicon carbide xx-fine</td>
<td>1.8</td>
<td>2.0</td>
<td>1.5</td>
<td>1.7</td>
<td>2.0</td>
<td>1.0</td>
<td>2.2</td>
<td>2.0</td>
<td></td>
</tr>
<tr>
<td>Abrasive-free</td>
<td>1.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.8</td>
</tr>
<tr>
<td>Shofu disk</td>
<td>2.9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dura-White stone</td>
<td>1.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The averaged results of the composite smoothness are designated by a rating number from 1 to 3, where 1 represents the smoothest possible results.
Table 4. Evaluation of Enamel Scratching

<table>
<thead>
<tr>
<th>Disk or Stone Used for Final Polishing</th>
<th>Adaptic</th>
<th>Concise</th>
<th>Vytol</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>H₂O</td>
<td>Vaseline</td>
<td>K-Y</td>
</tr>
<tr>
<td></td>
<td>dry</td>
<td>dry</td>
<td>dry</td>
</tr>
<tr>
<td>Adalox</td>
<td>2.0</td>
<td>1.6</td>
<td>1.5</td>
</tr>
<tr>
<td>Zirconium silicate</td>
<td>1.2</td>
<td>2.3</td>
<td>1.5</td>
</tr>
<tr>
<td>Silicon carbide, medium</td>
<td>2.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Silicon carbide, fine</td>
<td>3.0</td>
<td>2.2</td>
<td>2.5</td>
</tr>
<tr>
<td>Silicon carbide, x-fine</td>
<td>1.2</td>
<td>3.0</td>
<td>2.5</td>
</tr>
<tr>
<td>Silicon carbide, xx-fine</td>
<td>1.2</td>
<td>2.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Abrasive-free</td>
<td>1.0</td>
<td>1.0</td>
<td>2.8</td>
</tr>
<tr>
<td>Sof-Lex</td>
<td>2.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shofu disk</td>
<td>2.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dura-White stone</td>
<td>1.5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The averaged results of the severity of enamel scratching are designated by a rating number from 1 to 3, where 1 represents very little or no scratching.

FIG 1. The surface of this Vytol composite restoration has been finished with a fine silicon carbide disk (320 grit) without lubrication. Note that the filler particle (F) is level with the resin matrix (R) and that there is no evidence of the loss of fillers through abrasion (x1000).

FIG 2. This Adaptic surface has been finished with a white polystone run dry at high speed. The filler particle (F) has also been finished level with the resin matrix, but there is evidence of microcracking within the resin (R) and layering of the resin over the quartz particle, perhaps due to overheating during the procedure (x1000).
FIG 3. This Vytol composite restoration (C) has an extremely smooth surface and is rated 1. It was finished with an xx-fine silicon carbide disk (600 grit) with no lubricant. The filler particles are level with the resin matrix. The enamel (E) scratching is moderate and is rated 2 (x500).

FIG 4. This Concise composite restoration (C) has a moderately smooth surface and is rated 2. It was finished with a fine silicon carbide disk (320 grit) with a water spray. The enamel (E) scratching is severe and is rated 3 (x500).

FIG 5. This Adaptic restoration (C) has a rough surface and is rated 3. It was finished with a dry, fine silicon carbide disk (320 grit). The severity of the enamel scratching (E) is also rated 3 (x500).

FIG 6a. This is an Adaptic restoration that was contoured with a fine silicon carbide disk without lubrication and finished with an xx-fine silicon carbide disk with K-Y jelly (x500).

FIG 6b. One half of the restoration in Fig 6a was then buffed with an abrasive-free disk and water. Note the reduction in the severity of enamel scratching without obvious improvement in the smoothness of the composite (x500).

disk.” In Figures 6a & b the enamel approximating the Adaptic restoration has been polished almost free of scratches with the abrasive-free disk, after the restoration was first finished with fine and xx-fine silicon carbide disks used with water spray. There is no correlation between the use of lubricated disks and the smoothness of the finish of the composite surface (Table 3), but lubricating the silicon carbide disks with water, Vaseline, or K-Y jelly did aid in reducing scratches in the enamel (Table 4 and Fig 7). When we used an xx-fine disk lubricated with water during finishing and polishing, we occasionally found some black particles on the surface of the composites. Analysis of the par-
FIG 7. This Concise composite restoration was contoured with a fine silicon carbide (320 grit) disk lubricated with K-Y jelly, then polished with an xx-fine silicon carbide disk and an abrasive-free disk, also lubricated with K-Y jelly. K-Y jelly apparently offers no advantage over water when used with an abrasive-free disk to aid in reducing enamel scratching (x500).

Particles by x-ray microprobe disclosed them to be silicon carbide. When a contra angle with a reduction gear was used during the polishing, however, the particles were not as apparent.

DISCUSSION

Variations in Composites

The surface of Vytol was usually smoother than that of Concise and Adaptic because the particles of filler in each material differ in type, size, hardness, and amount. One would expect that materials with the smaller particles, which approximate the hardness of the resin matrix, would be abraded more uniformly than materials with larger and harder particles (Kanter & others, 1976). The matrix of all three materials is nearly identical, so one would expect that Vytol with a filler hardness of approximately 5 on the Mohs scale would show smoother surfaces than Adaptic with a filler hardness of approximately 7. In addition, the filler particles of Vytol typically showed abrasion marks (Fig 1), whereas none were visible on the filler priciles of Adaptic or Concise.

Silicon Carbide Disks

Silicon carbide disks, when used dry or with any of the three lubricants, abraded all of the materials faster and easier than any of the other disks or stones. Only minimum pressure and speed were necessary for reducing and polishing composite resin with these disks. Furthermore, silicon carbide disks seldom wore down before the restoration was completely contoured or polished, even when it was grossly overfilled. The softer aluminum oxide or zirconium silicate disks frequently required a second or third disk when reducing or polishing, especially when the filler particles were quartz.

Both medium (220 grit) and fine silicon carbide disks can be used effectively for gross reduction and contouring of the composite restoration, and surfaces of comparable smoothness can be obtained with or without the use of lubricants. When the disks are used dry, however, the margins are easier to visualize, but the amount of enamel scratching increases slightly. An xx-fine (400 grit) silicon carbide disk can also be used for gross reduction and contouring but is not as efficient as a fine disk. Nevertheless, the smoothness of the surface of the composite is extremely good.

The xx-fine silicon carbide disk is excellent for polishing since smoothness is greatly improved without obvious removal of the resin or filler. The smoothness of the composite resin is not improved when a lubricant is used here. The only problem with this disk is the potential of surface entrapment of the very fine black particles of silicon carbide, which can leave the surface of the restoration with a black-speckled appearance. The incidence and the amount of this speckling is unpredictable, but is reduced when the xx-fine disk is operated at slow speed, with light pressure, and with a water soluble lubricant such as K-Y jelly or with water alone.

Other Abrasive Agents

The aluminum oxide and zirconium silicate disks can leave a very smooth surface with considerably less scratching of the enamel than the silicon carbide disks. However, they do not abrade the harder filled materials very easily and require increased pressure and speed for efficient reduction and finishing. This necessitates frequent changes of disk, tends to overheat the surface resin, and to pull out the filler particles rather than abrade them. However, speckling is never a problem, since
The entrapped abrasive is not visualized. When increased speed and pressure are used in polishing, especially without lubrication, there is a layering or smearing of the resin phase, which tends to accumulate on the surface and may even cover the filler material. Also, when there is obvious overheating during polishing, the composite shows increased microcracks within the resin phase (Fig 2). The Sof-Lex disk (3M Co, St Paul, MN 55101, USA) consists of particles of aluminum oxide on a flexible disk and can result in a smooth surface. However, these disks cannot be used for gross reduction or contouring since they are too flexible to control adequately and can produce flattened contours. Also, the brass center can inadvertently touch the composite and leave an unesthetic mark. The Shofu polishing disk left a very uneven and rough surface and did not abrade satisfactorily the hard particles of quartz filler. The abrasive-free disk does not markedly increase the smoothness of the composite resin but most definitely reduces the enamel scratching produced by the xx-fine silicon carbide disk. Buffing with an abrasive-free disk and water does not increase the microcracking or the layering of the resin phase and therefore apparently does not overheat the surface of the polished composite. Buffing the surface with Vaseline or K-Y jelly as lubricants offers no advantage over water but does leave a glossy surface. How long this gloss would last clinically is only speculative.

**CONCLUSIONS**

1. The surface smoothness of a composite resin depends upon many factors, including the material itself, the manipulation and placement of the material, and the finishing technique.

2. Silicon carbide disks used in descending grit sizes are excellent for contouring and polishing, will abrade the hardest filler particles of a composite resin with ease, and leave an extremely smooth surface.

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The Pin-Retained Amalgam

A useful restoration for a large cavity or as a foundation for a crown

JAMES E. MOZER • RONALD W. WATSON

Summary

The pin-retained amalgam is a vital adjunct to the general practitioner in the restoration of badly decayed or broken teeth. This article discusses cavity preparation; indications for pins— their number, position, and type; whether the amalgam is to be the final restoration or a foundation for a crown; selection of the alloy; placing a matrix; and condensing, carving, and polishing the amalgam.

Introduction

Placing large pin-retained restorations of amalgam is not a formidable exercise fit only for gifted operators but should lie within the capability of every general practitioner.

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Pins—Who Needs Them?

Teeth with extensive breakdown from caries or fracture need pins to enhance the retention of an enlarged cavity preparation (Moffa, Razanno & Doyle, 1969). Pins do not reinforce amalgam or increase its strength; in fact the presence of pins may weaken the amalgam (Going & others, 1968). Just as pins help bind amalgam to tooth structure, they also help to bind weak tooth structure to amalgam (Dawson, 1970); for example, properly placed cross pins can help to bind a thin weak cusp to a mass of amalgam retained by additional pins positioned vertically.

Cavity Preparation—Where Success Begins

The principles of cavity preparation for the pin-retained amalgam are no different from those of any other preparation; retentive pins do not obviate the need for sound cavity preparations (Dawson, 1970).

The first consideration is to conserve as much of the remaining tooth structure as possible. All weak or carious tooth structure is removed. The tooth structure remaining then determines how the cavity preparation is to be completed. Sound dentin and enamel are adapted to attain as much retention and resistance form as possible.
Retention can be created in several ways, with proper orientation of walls being of prime importance. Existing facial and lingual walls should be parallel rather than converge occlusally. Whenever possible the axial wall should be perpendicular to the pulpal and gingival walls. Stresses are distributed more homogeneously throughout the mass of amalgam when the prepared cavity presents parallel and perpendicular walls (Mondelli & Vieira, 1972). Grooves placed into sound dentin are also important aids to retention. Thus, the approximal areas of the tooth should contain boxes with retention grooves whenever practical. Pins are considered to be extensions of retentive grooves. Occasionally, additional retention may be provided by placing dovetails in the remaining tooth structure on the occlusal surface.

Any area that is to receive a vertical pin should be flat, perpendicular to the long axis of the tooth, and should present a zone of dentin sufficiently wide for placement of a pin. Of paramount importance is a prepared cavity that will allow adequate bulk of amalgam for strength in any given area. In general, any area designed to receive a pin should be reduced enough to allow a pin length of 2.0 mm, an amalgam covering of at least 0.5 mm around the pin and 2.0 mm occlusal to the pin.

Pin Position, Applied Forces, and Amalgam Strength

The position of the pin in relation to the forces applied to a mass of amalgam and the resulting influence on the strength of the restoration is a confusing subject to say the least. The confusion arises because much of the research has been performed on amalgam specimens outside the mouth, leaving it to the practitioner to relate such information to clinical variables such as cavity preparation and occlusal forces. Nonetheless, some valuable information has been obtained.

The tensile strength of dental amalgam is approximately 17% of its compressive strength (Courtaud & Timmermans, 1971). Clinically, tensile or transverse strength, or both, may be of greater significance than compressive strength (Mahler, 1958; Rodriguez & Dickson, 1962; Mahler & Mitcham, 1964). In fact, photoelastic analysis of stress suggests that tensile stress may be a major factor in amalgam failure (Granath, 1964 a,b).

Pins positioned with long axes perpendicular or diagonal to tensile stresses decrease the tensile strength of amalgam significantly, whereas pins positioned with long axes parallel to tensile stresses do not result in any significant decrease in tensile strength (Going & others, 1968).

Laboratory studies conducted by Cecconi & Asgar (1971) employing pins positioned in cylinders of amalgam have shed some additional light on the effect of the orientation of pins to applied forces. When a single pin was positioned vertically to simulate clinical use, and located in the center of the specimen, the amalgam was significantly weakened. However, a single pin positioned to one side caused no significant decrease in tensile strength. The authors concluded that the presence of even one vertical pin may weaken a restoration because we cannot predict with certainty whether or not a load point will fall directly over such a pin. They further concluded that increasing the number of vertical pins would simply increase the possibility of an unfavorable relationship of load to pin position, resulting in a restoration more susceptible to fracture. In view of this research are we warranted in placing vertical pins? We feel the answer to this question is, "Yes."

In clinical situations, the vertical position is frequently the only practical position available. Cecconi & Asgar (1971) also admit that the goal of maintaining pins parallel to tensile forces is difficult because tensile forces that do not weaken the restoration in one direction may weaken it in another.

The effect on amalgam strength of bending pins or positioning pins at various angles has also been investigated, with diverse results. Some researchers have indicated that bent pins may increase the strength of amalgam when the stresses are not applied over the pin sites, but that straight pins weaken amalgam (Mondelli & Vieira, 1972). However, others have investigated the effect of pins placed at an angle of 45 degrees and pins bent at an angle of 90 degrees, and have concluded that such angled or bent pins weaken amalgam as much as straight pins (Cecconi & Asgar, 1971).

The research to date does not tell a clear and complete story, yet dentists continue to
use pins. In the following section some precise guidelines for placement of pins will be presented.

Optimal Position and Number of Pins

Having prepared a cavity according to sound principles, the dentist must decide on the appropriate number of pins to be placed and locate the optimal positions. Since there is a progressive decrease in tensile strength as the number of pins is increased, the minimum number of pins compatible with adequate retention should be used (Cecconi & Asgar, 1971; Duperon & Kasloff, 1973).

What, then, is a practical guide for determining the optimal number of pins? One pin should be used to replace each totally missing proximal wall. With this criterion, a posterior tooth needs from one to four pins. In the event a proximal wall is partly missing, as occurs with partial reduction of a cusp, a pin should still be used if the reduced cusp is centric-bearing.

The optimal position of a pin depends on several factors, first of which is the internal morphology of the cavity. A pin should not lie flush against an axial or proximal wall as retention would be greatly reduced. Secondly, the external morphology of the tooth must be considered. To avoid perforation into the periodontal ligament a pin should never be placed directly over a furcation. Thirdly, the anticipated bulk of amalgam must be considered, since pins placed in areas of greater bulk are less likely to weaken the amalgam (Mondelli & Vieira, 1972). Finally, the anticipated points of occlusal load must be considered since a vertical pin positioned directly below an occlusal load weakens the amalgam significantly (Cecconi & Asgar, 1971). In view of these facts, the proximal line angles of the tooth are excellent locations for pins. At the proximal line angle the pin is unlikely to penetrate into a furcation, the bulk of amalgam is usually sufficient, and points of occlusal load seldom occur.

Once the general position of a pin has been determined, the precise location of the channel for the pin in relation to the dentino-enamel junction must be established. Prior to making the channel, a starting point should be placed into dentin with a number 2 round bur at low speed. Where the cervical margin adjacent to a proposed site for a pin is below the cemento-enamel junction, the channel for the pin should be placed midway between the external surface of the tooth and the pulp chamber. If the cervical margin is located more coronally, the channel should be placed into the dentin leaving approximately 0.5 to 1.0 mm of dentin between the periphery of the channel and the dentino-enamel junction to minimize crazing of adjacent dentin. Channels for pins should not be placed close together as this also encourages crazing (Dilts & others, 1970). If a pin-retained restoration of amalgam is placed as a foundation with the intention of preparing the tooth for a casting, each pin should be placed so that it will not be removed or disturbed by the preparation of the tooth.

Care must be taken to avoid encroaching on the pulp or perforating the periodontal ligament. To avoid improper direction in drilling the channel for the pin, the twist drill should be placed parallel to the external surface of the tooth adjacent to the pin site, thus establishing the proper angle of entry.

Types of Pin

Three main types of pin are used—the cemented pin, friction-lock pin, and self-threading pin. Other types of pin and retaining device have been used but these three remain the most widely accepted.

The cemented pin was first introduced by Markley in 1956 and represented the first standardized technique of retaining amalgam restorations. This technique employs threaded pins of varying lengths that are cemented into prepared channels in the dentin. The channels are drilled 2 to 4 mm into the dentin and are 0.002 inch larger in diameter than the pins. Thus, the retention in this method depends upon the cement.

In contrast, the friction-lock pin relies on the elasticity of dentin for retention (Goldstein, 1966). The pins are 0.001 inch larger than the prepared channels in the dentin and are driven into place by use of a pin holder and mallet. The self-threading pin also employs the elasticity of dentin for retention. The threaded pins used in this technique should be no more than 0.002 inch or less than 0.001 inch larger than the diameter of the drilled channel to achieve optimal retention. Threaded pins are
available in various sizes and are screwed into place with a small hand wrench or a special handpiece with a 10 to 1 reduction gear.

Retention

Research has shown the self-threading pin to be the most retentive in dentin, the friction-lock pin second, and the cemented pin the least retentive (Welk & Dilts, 1969). Their investigation indicated that a depth of channel of 2.0 to 3.0 mm in dentin provides optimal retention when using the self-threading pin. Even with channel depths of 4.0 mm, the friction-lock and cemented pins exhibited significantly less retention than the self-threading pin inserted to a depth of 2.0 mm. An additional factor in retention is the depth of the pin in amalgam. A comparison of threaded, friction-lock, and self-threading pins revealed that all the pins except the friction-lock fractured under tension when embedded more than 2.0 mm in amalgam—the friction-lock pin simply pulled out of the amalgam without fracturing the pin (Welk & Dilts, 1969). The conclusion was that friction-lock pins were less retentive in amalgam than threaded and self-threading pins, provided that all were embedded to the same depth in amalgam. It would appear from this study and also the work of Moffa & others (1969) that a pin depth of 2.0 mm in amalgam is close to optimal. Increasing the diameter of the pin produces a concomitant increase in retention when using cemented and self-threading pins (Moffa & others, 1969).

When multiple pins are placed they should not be positioned parallel to each other but at slightly different angles for maximum retention. It is not necessary to bend the picks for retention, but bending may be necessary to allow for an adequate bulk of amalgam around the pins (Dawson, 1970).

Microleakage

The quality of the interface of amalgam and tooth surface will determine the initial potential for microleakage. Because pins are used in most cases where there has been extensive damage to the existing tooth structure, the pins are often located close to the pulp. Therefore, if microleakage does eventually extend to the pin sites, the results may be harmful.

Cavity varnish eliminates microleakage around both the friction-lock and the self-threading pins, but only decreases the microleakage around the cemented pins (Moffa, Razzano & Folio, 1968). A negative result of the cavity varnish is that it decreases the retention of the cemented pin. However, little or no effect on retention is observed when cavity varnish is used with the friction-lock and self-threading pins.

Final Restoration or Foundation?

The extent of the loss of tooth structure, as well as the patient's occlusion, determines if a pin-retained amalgam would be sufficiently strong and retentive to last a reasonable period of time. If the total centric-bearing side of a posterior tooth requires restoration, such as an MODF involving both facial cusps on a lower second molar, restoration should be limited to a foundation rather than a finished procedure. Whenever one centric-bearing cusp plus both noncentric-bearing cusps of a molar require restoration, a foundation and subsequent casting is usually the treatment of choice. The restorative involvement of other teeth in the same quadrant should also be taken into account. Amalgam should not be used as a final restoration to replace centric-bearing cusps on two or more molars in the same quadrant.

Consideration of the periodontium is also essential to a well-thought-out treatment plan. The potential to develop physiologic axial contours, in addition to adequate occlusion, will ultimately affect the periodontal health of the tooth. Flat proximal surfaces meeting marginal ridges at a right angle, resulting in contacts impervious to the entry of dental floss, are an embarrassment to the dental profession. If a well-contoured matrix cannot be placed because of extensive loss of tooth structure, or if limited access precludes proper sculpturing of the amalgam, the restoration should be a foundation.

Also relevant to periodontal health are the location and quality of the cervical margins. Subgingival placement of restorations enhances accumulation of plaque and gingival inflammation (Silness, 1970; Loe, 1968; Larato, 1969, 1972). Whenever feasible, margins of restorations should be placed supragingivally to avoid contact with gingiva and to allow adequate access for proper contouring, finish-
ing, and polishing. However, if extensive loss of tooth structure dictates placing most of the margins subgingivally, the amalgam should be placed as a foundation. Subsequently a casting should be placed with physiologic axial contours and accurately adapted, highly polished margins. Restorations should never be placed closer than 1.5 mm to any portion of the alveolus to avoid infringement upon the epithelial attachment (Gargiulo, Wentz & Orban, 1961). Violation of this attachment may lead to resorption of bone in the involved area. In certain instances, surgical contouring of bone is indicated before restoring teeth with margins located excessively deep within the periodontium.

The Restorative Material—Does It Really Matter?

With the advent of the new high-copper alloys, a major advantage could well be their early tensile strength and one-hour compressive strength. High-copper alloys exhibit an early tensile strength averaging 14% greater and a one-hour compressive strength averaging 27% greater than the conventional alloys (Eames & MacNamara, 1976). Another advantage of the high-copper alloys is their low static creep.

Setting time is an additional variable that must be considered in selecting an alloy since the operator must have adequate time for condensing and carving. A large restoration requiring extensive carving is a potential indication for a slow-setting alloy, depending on the operator’s speed. On the other hand, an amalgam to be used as a foundation may dictate the use of a faster setting alloy, since less carving is required and early strength is desirable if the tooth is to be prepared for a casting at the same visit.

Matrix Placement

The Tofflemire retainer can usually be successfully placed if adequate cusps remain and cervical margins are not located too far apically. However, with excessive loss of cusps, a copper band may have to be adapted as a matrix to gain adequate stability and to contain the amalgam. In this event the amalgam should usually be considered a foundation for a subsequent casting rather than a finished restoration, since proper axial contours and proximal contacts are most difficult to achieve with a copper band. If a final restoration is desired, the matrix band should be positioned to seal the cervical cavosurface margins and should extend far enough occlusally to be slightly higher than the cusp tips are estimated to be when restored with amalgam. After proper placement of the matrix and wedges, the band should be contoured with an appropriate burnisher to establish definite contact with adjacent teeth and to allow development of physiologic axial contours. Recent research (Powell, Nichols & Shurtz, 1977) has indicated a potential hazard when using a matrix retainer, such as the Tofflemire, that must be tightened around the tooth for retention. Such a matrix deforms the tooth elastically. After this deformation is recovered upon removal of the band, a gap appears between cavity wall and amalgam. The Tofflemire retainer can still be successfully used, but excessive tightening of the band should be avoided, wedges should be properly placed to seal cervical margins, the matrix should be reinforced with modeling compound if necessary to gain stability, and a protective varnish should be placed over the dentinal tubules.

Amalgam Condensation

Placement and condensation of amalgam should begin with small increments in the area immediately surrounding each pin, gradually proceeding outward to the cervical cavosurface margins. After all step areas, proximal boxes, and pin areas have been completely filled, resulting in a flat amalgam surface, successive larger increments should be added rapidly, spread out evenly, and then forcefully condensed. This increased rate of condensation is essential since the greater the elapsed time between triturating and condensation, the greater the loss in strength (Mahler, 1967; Phillips, 1973). Equally important is the condensation pressure applied, which should be as great as is practicable. In one study involving 30 practitioners, typical forces ranged from 1 to 6 pounds (Mahler & Mitchel, 1965). Condensation pressure should be appropriate to the type of alloy employed, since greater forces are in-
dicated for conventional alloys and blends than for spherical alloys. Forceful condensa-
tion minimizes the free mercury in the amal-
gam mass and reduces the formation of $\gamma_1$ and $\gamma_2$, resulting in increased strength, decreased expansion, decreased flow, and, ultimately, decreased creep and marginal breakdown.

A sufficient quantity of amalgam should be condensed to ensure that the matrix is com-
pletely filled to a level slightly higher than the restored cusp tips are estimated to be. This is
most important, especially if centric-bearing cusps are involved, since they should be
placed in occlusion. In general, cusps restored in amalgam should exhibit a height and form
that is characteristic of the patient's natural dentition. Otherwise, the resulting restoration
is merely a space maintainer.

Carving the Restoration

Carving a large restoration can be greatly
simplified by following an established regimen
in preference to random carving. After remov-
ing the rubber dam, adjust the occlusion to be
in harmony with all jaw movements.

Polishing the Restoration

Polishing is recommended if the amalgam is
to serve as a final restoration and is even more
important with extensive restorations where the
proximity of the margins to gingiva is
greatly increased. As preparation for polishing,
a technique that works well is to surface the
set amalgam upon completion of carving with a
wet mix of flour of pumice applied with a soft,
webless rubber cup. If light, intermittent
strokes are employed, the restoration main-
tains the established contour and presents a
smooth, dull surface that can be more quickly
polished at a subsequent appointment.

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Modifications to the Design of Dental Instruments for Operating from a Seated Position

Modifying the shape of some conventional instruments makes them more convenient to use by a seated operator.

DONALD R THARP • MELVIN R LUND

Summary

The designs of enamel hatchets, the Hollenback carver, and the cleid carver have been modified to improve their efficiency when used from a seated operating position.

The operating positions and movements required of a restorative dentist have changed significantly in recent years. The traditional working positions have been standing, either in front of the patient (using direct vision) or behind the patient (working with a mirror). Dental equipment and instruments have been designed for use in these operating positions. However, the development of operating from a seated position has necessitated changes in the design of equipment and instruments.

When working from a seated position the operator seeks to minimize awkward movements of body and arms that tend to cause muscle strain and fatigue (Kilpatrick, 1974). Although many of the traditional instruments can be conveniently adapted to the modern sit-down style, some are not so versatile. Therefore the design of dental hand instruments should be evaluated to ensure that they are well suited for use by a seated operator and, if not, to consider possible improvements.

The conventional enamel hatchet illustrates this point. To employ this instrument in all the required areas of a lower arch, a seated operator must make several shifts in position of body, arm, and hand. However, changing the angle of the blade to the shank a few degrees minimizes the problem (Fig 1). This modified instrument can be used with good control when maximum force is needed to prepare a cavity wall or when delicate movements are needed to finish an enamel margin.

Another instrument that can be made more versatile by modification is the popular Hollenback No 3 amalgam carver (Fig 2). Working strictly from a standing position, an operator can make the moves necessary to use this instrument effectively. However, as with the enamel hatchet, a seated operator is forced into many stressful shifts and twists in order to carve a restoration from both the facial and lingual directions. A slight modification of the design makes the instrument more accessible to all areas of the tooth and imposes much less strain on the operator (Figs 3a & b).

The same type of modification described for the Hollenback carver can be used with other
FIG 1. A conventional enamel hatchet (top) and the more versatile modified instrument (bottom).

FIG 2. A regular Hollenback No 3 amalgam carver (top) is shown next to the modified version (IU Tharp 1, American Dental Mfg Co, Missoula, MT 59801, USA). One end of the new instrument is the standard carver and the other end is designed for carving from the backhand direction.

instruments such as a cleoid carver (Fig 4).

The modified carving instruments have these specific advantages over the conventional types:

- The operator may do all the carving from the same position without twisting his body or arm, while maintaining the same finger rest for carving from both facial and lingual directions.
- Having the same carving blade available at two different angles enables the operator to gain better access to all areas of the restoration simply by alternating the working ends.
- The operator's position does not interfere with the illumination or view of the working area—a convenience to both operator and assistant.
- Marginal ridges and approximal areas (particularly the distal), which are difficult to reach with conventionally styled instruments, can often be carved with instruments of the new design.
- As carving is simplified, it becomes easier to teach to beginners.

(Accepted 7/3/78)
PRODUCT REPORT

Working Times of Amalgam Alloys Compared

WILMER B EAMES • CRAIG T AJMO
C OWENS PALMERTREE, JR

Summary

The plasticity of nine alloys, each in a variety of marketed forms, was measured by an indentation method with a Durometer to determine relative working times (optimum time to end of condensation). Depths of penetration of the needle, as a function of time, determined whether the setting time was fast, regular, or slow.

Fast setting alloys: Sybraloy Fast Set tablets, Disperalloy Fast Set tablets and Tytin Regular Set 800 mg Precapsulated.

Regular setting alloys: Aristaloy CR tablets, Tytin Regular Set 600 mg Precapsulated.

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lated and Slow Set 800 mg Precapsulated, Indiloy Regular Set tablets, Ease tablets and Precapsulated, Sybraloy Regular Set tablets and Precapsulated, and Cupralloy.

Slow setting alloys: Tytin Regular Set tablets, Micro II tablets, Disperalloy Regular Set tablets and Precapsulated form, and New True Dentalloy.

INTRODUCTION

The term 'working time' has a loose connotation in dentistry, often being confused with, or used in place of, 'carving time' and 'setting time.' Our interpretation is that the working time of amalgam, measured from the end of triturating, is the optimum time during which a mix of amalgam can be properly condensed. This requires that the mix remain plastic, allowing mercury to be removed during condensation, so that the resultant restoration will not be layered and will have maximal strength at the occlusal margins. Carving time is the time, from the end of triturating, in which a condensed amalgam can be smoothly carved without crumbling.

The properties of amalgam during early setting have been observed by the Council on Dental Materials and Devices of the American Dental Association using tensile tests, shear tests, and scratch tests. Investigators have also measured nonfracture of an amalgam ball with a Gillmore needle (Nagai & others, 1968), as well as absorption of mercury (Jørgensen,
1973), depth of cut with a guillotine device (Ohashi, Ware & Docking, 1975), cohesion (Eames & Skinner, 1965), plasticity (Mahler, 1967), and damping of ultrasonic waves (Davidson, Arends & Harkel, 1974). These are all effective in measuring certain qualities of the amalgam, but most fail to relate to the dental practitioner what he may or may not expect in handling characteristics from his alloy.

Working times of amalgam given by alloy manufacturers in their instruction sheets (fast, regular, and slow set), are of minimum guidance since testing methods are not standardized.

With a Durometer (Fig 1—Type D conforming to ASTM D-2240-75, Model 307, Pacific Transducer Corp, Los Angeles, CA 90064, USA), it is possible to monitor the early setting rate of amalgam, using load (derived from pin indentation) as a function of time.

MATERIALS

The materials tested are listed in the table.

<table>
<thead>
<tr>
<th>Amalgam alloys tested</th>
<th>Product</th>
<th>Type</th>
<th>Manufacturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Aristalloy CR</td>
<td>Tablets</td>
<td>Baker Dental Carteret, NJ 07008, USA</td>
</tr>
<tr>
<td>1</td>
<td>Cupralloy</td>
<td>Tablets</td>
<td>Star Dental Manufacturing Co Conshohocken, PA 19428, USA</td>
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<tr>
<td>1</td>
<td>Dispersalloy</td>
<td>Fast Set tablets</td>
<td>Johnson &amp; Johnson Dental Products Company East Windsor, NJ 08520, USA</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td>Regular Set tablets</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
<td>Precapsulated</td>
<td>L D Caulk Company Milford, DE 19963, USA</td>
</tr>
<tr>
<td>1</td>
<td>Ease</td>
<td>Precapsulated</td>
<td>Shofu Dental Corporation Menlo Park, CA 94025, USA</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td>Regular Set tablets</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Indiloy</td>
<td>Regular Set tablets</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Micro II</td>
<td>Tablets</td>
<td>L D Caulk Co S S White Dental Products Philadelphia, PA 19102, USA</td>
</tr>
<tr>
<td>1</td>
<td>New True Dentalloy</td>
<td>Tablets</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Sybraloy</td>
<td>Fast Set tablets</td>
<td>Sybron/Kerr Romulus, MI 48174, USA</td>
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<tr>
<td>1</td>
<td></td>
<td>Regular Set tablets</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
<td>Precapsulated Regular</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Tytin</td>
<td>Precap Regular 600 mg</td>
<td>S S White Dental Products</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td>Precap Regular 800 mg</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
<td>Precap Slow Set 800 mg</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
<td>Regular Set tablets</td>
<td></td>
</tr>
</tbody>
</table>

METHODS

A triple spill, or two double spills, of each alloy were triturated at room temperature (23 ± 2 °C) according to manufacturer's specifications. Two double spills were used when man-
ufacturers' instructions did not recommend a triple spill, when using precapsulated alloy, or when a triple spill was not adequate to fill the mold, for example when using 4.5 grain (30 mg) pellets.

Specimens were triturated with a Wig-L-Bug S C 40 (Crescent Dental Mfg Co, Lyons, IL 60534, USA) for a triple spill, and Wig-L-Bug S C 40 with a Wig-L-Bug AR-5, operating simultaneously with a Gra-Lab Clock model No 171 (Dimco-Gray Co, Centerville, OH 45459, USA), for two double spills. The amalgamators were calibrated with a strobe light to ensure consistent operating speeds. A Wig-L-Bug model 10 at high speed was used for Dispersalloy since an AR-5 is not recommended. Within 30 seconds of the beginning of trituration the entire mix was milled in one capsule for a second. The mix was shaped lightly with fingers (Fig 2) and placed into a split die having a recess with a diameter of 6.7 mm and a depth of 4.2 mm, and a rounded bottom to allow for complete adaptation of the mass of amalgam.

The amalgam specimen was pressed into the die with a digital pressure of only 0.5–1.5 kg, the pressure varying slightly with each brand of manufacturer's alloy and measured with a Dillon gauge (W C Dillon & Co, Van Nuys, CA 91407, USA) mounted under a stage, a special effort being made not to bring up any mercury by compaction. There was a minimum overpacking of 2–3 mm in each test. The bulk was removed with a razor blade, leaving approximately 0.5 mm, which was then removed with a second cut, resulting in a smooth, flat surface flush with that of the die. The die was placed on the stage of a Chatillon electric table (John Chatillon & Sons Co, New York, NY 11415, USA), model No HTCM, serial No 240 (Fig 3), moving at 3.5 cm/min until the surface of the die was firmly set against the foot of the Durometer. The Chatillon gauge was loaded with 20–40 lb (8.8–17.6 N) at this stage.

The Durometer has a cone-shaped pin, protruding 2.5 mm from the base of the instrument (Fig 4), which measures loads from 0 to 10 lb (0–4.54 kg). For each trial the highest reading of the Durometer was recorded with an ancillary pointer. A sudden dropping of the Durometer needle usually indicated a void in the specimen, and such readings were discarded. After readings were recorded, the specimens

FIG 2. Amalgam mix is shaped before inserting into split die.

FIG 3. Chatillon table with mounted Durometer. Split die is in place.

FIG 4. Cone-shaped Durometer pin is shown indenting prepared amalgam mass.
were removed from the dies and inspected for any major cracks or voids. Readings from the specimens with cracks or voids were also discarded. Minor cracks of the surface and slivering were sometimes unavoidable with some alloys.

A mix was placed into each of three dies and three indentations were made in each die (Fig 5), giving a total of nine readings, which were made at one-minute intervals from two to ten minutes. This procedure was done five times for each alloy. Standard deviations were all under 15% and most under 10%.

RESULTS

Figure 6 shows setting patterns of the alloys during the period from two to six minutes after trituration. The alloys fall into three distinct categories.

FIG 5. Amalgam specimen in split die after it has been tested. Filling all three recesses allows a total of nine readings to be taken.

The Durometer reading at 3.5 minutes was chosen to separate categories since most operators can condense a mix within this time, and 3.5 minutes is considered the optimum limit for condensing (Phillips, 1973). An alloy having a 3.5 minute Durometer reading above 5.0 lb (2.3 kg) was characterized as fast set-
TING, between 3.8 lb (1.7 kg) and 5.0 lb (2.3 kg) as regular setting, and below 3.8 lb (1.7 kg) as slow setting. These values are not related to condensing forces.

**DISCUSSION**

There is no standard for determining the setting rate of an alloy, so choosing types and brands of alloys without having had previous experience is frequently arbitrary. This may apply also to the same alloy in different form. For example, by this test Tytin tablets (Fig 7) are slow setting; Tytin Precapsulated Regular Set 600 mg and Precapsulated Slow Set 800 mg are regular setting; and Tytin Precapsulated Regular Set 800 mg the most rapidly setting. This is conflicting since dentists require more time to condense 800 mg of alloy than 600 mg.

Sybraloy (Fig 8) also differs markedly in the setting patterns of its Fast Set tablets and Fast Set Precapsulated alloys.

Although in theory an absolute working time could be determined for each alloy, in practice this is difficult since the condensing technique is a major determinant of working time. An operator using a small serrated condenser with a lateral scrubbing motion and many firm thrusts will obtain a longer working time and a stronger restoration than the operator who uses vertical thrusts with a large smooth condenser (Eames, 1967).

The information presented here allows the clinician to compare other alloys with the one he is currently using and make the proper choice to suit his particular needs.
FIG 8. Sybraloy Regular Set shows same setting pattern in precapsulated and tablet form, but the Fast Set shows markedly different patterns.

This study was supported in part by the National Institutes of Health, National Institute of Dental Research, Research Grant 5 RO 1 DE 03504-09, USPHS Grant RR 05308, and by the Fifth District Dental Society of Atlanta.

References


Mercury Leakage during Trituration

WILLIAM N VON DER LEHR • CAMILLE B CAPDEBOSCO

The winter 1979, volume 4, number 1 issue of Operative Dentistry contains a report on the leakage of mercury from seven brands of reusable capsules and five brands of disposable capsules. Two additional capsules have now been tested.

Material

At the request of the S S White Company (Philadelphia, PA 19102, USA) the same test was made on their new reusable capsule, which has a beveled end secured by a screw top and contains a metal pestle. One other disposable capsule, containing Ease—an admixture, high-copper alloy by Caulk (L D Caulk Co, Milford, DE 19963, USA)—was also tested.

Method

The method used to evaluate the capsules is explained in the aforementioned article.

Results

The results for all brands tested are given in the table. For the new S S White capsule, nine trials showed four with no leakage. The most leakage was 0.3 mg. Total leakage for the nine trials was 1.0 mg and the mean was 0.11 mg. This is the least leakage exhibited by any reusable capsule tested yet.

Leakage for the Ease capsules, at 12 seconds trituration, ranged from 0 mg to 0.4 mg with a 1.2 mg total and 0.20 mg mean. This places Ease fourth out of the six disposable brands tested, when ranked from least to most leakage.
### Mercury leakage of reusable and disposable capsules after nine trials

<table>
<thead>
<tr>
<th>Brand</th>
<th>Total mg</th>
<th>Mean mg</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Reusable</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S S White (new product)</td>
<td>1.0</td>
<td>0.11</td>
</tr>
<tr>
<td>(Philadelphia, PA 19102, USA)</td>
<td></td>
<td></td>
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<tr>
<td>L D Caulk Co</td>
<td>1.3</td>
<td>0.14</td>
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<tr>
<td>(Milford, DE 19963, USA)</td>
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<tr>
<td>Shofu Dental Corp</td>
<td>1.4</td>
<td>0.15</td>
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<td>(Menlo Park, CA 94025, USA)</td>
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<td>Crescent Dental Mfg Co</td>
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<td>Baker Dental</td>
<td>2.1</td>
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<td>(Carteret, NJ 07008, USA)</td>
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<td></td>
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<td>Kerr Mfg Co</td>
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<tr>
<td>S S White (old product)</td>
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<td>0.67</td>
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<td>Johnson &amp; Johnson Dental Products Co</td>
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<td>(East Windsor, NJ 08520, USA)</td>
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<td><strong>Disposable</strong></td>
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<td></td>
</tr>
<tr>
<td>Tytin (S S White)</td>
<td>0</td>
<td>0</td>
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<tr>
<td>Indiloy (Shofu Dental Corp)</td>
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<td>0.13</td>
</tr>
<tr>
<td>Sybraloy (Kerr Mfg Co)</td>
<td>0.9</td>
<td>0.15</td>
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<td><strong>Ease</strong></td>
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<td>(L D Caulk Co)</td>
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<td>0.20</td>
</tr>
<tr>
<td>Aristaloy (Baker Dental)</td>
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</tr>
<tr>
<td>Fine Cut (L D Caulk Co)</td>
<td>2.4</td>
<td>0.40</td>
</tr>
</tbody>
</table>

### Discussion

For those dentists using reusable capsules, the new S S White product is exciting. The study shows that this reusable capsule is now in the range exhibited by the disposable or premeasured capsules. Ease leaked, but less than its competitors that were also mixed for 12 seconds. Leakage from disposable capsules is directly affected by trituration time and 12 seconds was the longest time tested.

### Conclusion

Progress is being made in the manufacture of capsules. A reusable capsule that reduces leakage to a level approximately that of the disposable capsules is now available.
POINT OF VIEW

A Dictionary of Operative Dentistry

ROBERT E GOING

What better way to publicize the comprehensive nature of operative dentistry than through a book containing the language of such an important part of the dental profession! What better way to cultivate respect and appreciation for a discipline that has served as the cornerstone of dentistry for so many years, and now deserves recognition as a specialty!

The terminology of operative dentistry has served as a standard of dental language since G V Black advanced the scientific method in dentistry and furthered the conservation of teeth. Any new terms introduced have been perpetuated largely through textbooks of operative dentistry. Professors and students use these terms in a wide range of combinations that can be confusing when poorly understood.

With the present explosion of new restorative materials, techniques, and devices pertinent to the practice of modern operative dentistry, it is time to redefine the language in a single book that will serve as a standard of restorative dentistry for the future. Since the practice of operative dentistry today embraces broad concepts that challenge students, teachers, and general practitioners alike to maintain a full complement of teeth in health and function throughout a patient’s life-time, saving the natural dentition is no longer a fantasy. The late Arthur D Black stated that: “Operative Dentistry consists of all procedures, including preventive measures, by which the teeth may be conserved and thus maintain the natural masticating mechanism in such a state that the general health will not be endangered.”

Who should prepare the new Dictionary of Operative Dentistry? What better qualified individuals are available than the members of the Academy of Operative Dentistry! Through a disciplined organization of manpower, this worthy project could be begun in the immediate future and completed within a reasonable period of time. We have enough time now to

Temple University, School of Dentistry, Health Sciences Center, Department of Operative Dentistry, Philadelphia, PA 19140, USA

ROBERT E GOING, DDS, MS, professor and chairman. He is a charter member of the Academy of Operative Dentistry and a fellow of the American College of Dentists.
develop a feasible plan that could be introduced to the members of the academy at the annual meeting in February. The Dictionary of Operative Dentistry could be an academy project under the leadership of acknowledged authorities, and all proceeds from its publication dedicated to the enrichment of the programs of the academy and the journal, Operative Dentistry. If the membership fails to accept the challenge and the opportunity to author and monitor this dictionary, be assured that someone with less insight, dedication, and expertise will certainly do so.

"The knowledge of words is the gate of scholarship," said John Wilson. What better way to contribute to the improved teaching and understanding of operative dentistry than to use words with renewed meaning and emphasis to guide us in our future progress.

(Editor's note: Anyone having an interest in this idea or comments about it, either for or against, should write as soon as possible to the editor.)

Reference
Distinguished Member Award

Ralph A. Boelsche has been given the first Distinguished Member Award of the American Academy of Gold Foil Operators. This annual award has been established to honor members of the academy for major contributions to dentistry. The signal honor of the first award goes to a man who exemplifies the highest ideals in the practice of dentistry.

Dr. Boelsche graduated in 1927 as valedictorian from the School of Dentistry of the University of Texas in Houston. He conducted a private practice in Houston until his retirement in August 1979. During his long and successful career he took every opportunity to augment his education and polish his skills so that he could provide better service for his patients. Always an enthusiastic advocate of the use of gold foil, he became a charter member of the American Academy of Gold Foil Operators, succeeded to its presidency in 1957, and for 11 years served as business manager of its journal. He is a charter member also of the Houston Gold Foil Study Club and has been its mentor since 1952. He is a member of the Woodbury Gold Foil Study Club and has taken the course of instruction on gold foil given by the Associated Ferrier Study Clubs of Washington and British Columbia.

Dr. Boelsche has contributed greatly to dental organizations, having been president of the Houston District Dental Society, a reporter of research and new endeavors in dentistry for the Texas Dental Association, president of the American Academy of Restorative Dentistry and the Southwestern Academy of Restorative Dentistry, and a regent of the American College of Dentists. He is also a member of the Pierre Fauchard Academy and the American Academy of Endodontists and a fellow of the International College of Dentists.

Ralph is a gentleman whose high sense of moral integrity is a joy to all who know him. He has always given generously of himself to advance his profession and help his colleagues. His warm personality and his kind and gentle manner reflect an obvious faith in his fellow man. He has enriched dentistry by his presence and is truly a benefactor of society.
The plaque (left) presented to Dr. Boelsche at the meeting. Another plaque (right) bearing his name will be displayed at the American Dental Association in Chicago.

Dr. José Medina presents the first Distinguished Member Award to Dr. Boelsche at the 1979 annual meeting of the American Academy of Gold Foil Operators. Photo courtesy of Bill Roberts.
Dear Woody

Dear Woody:

There are several techniques being advocated for the finish of amalgam surfaces at the time of placement. What are the advantages and disadvantages of: 1) leaving the surface as carved, 2) burnishing, 3) gently polishing with a soft rubber cup and fine wet abrasive; and 4) waiting 15 minutes and polishing with pumice and tin oxide?

Carly S. DeKay, DDS
Pitt City, Arizona

Letters

Dear Sir:

I wish to respond to Dr. Bernard L. Abrams’ letter in the Winter 1979 issue [Vol. 4, no. 1, pp. 45-46] in which he criticizes “specialization” in operative dentistry and cites specifically an advertisement from the University of Michigan for an assistant professor in operative dentistry requiring an MS.

1. Such an advanced degree beyond the DDS is required for any professorial appointment at this school. Such a policy has been in existence for longer than 35 years.

2. Although this additional degree does not necessarily assure excellence in teaching, it is evidence of education and training that, all other things being equal, should contribute positively to student learning. The reputation of this school and its graduates can speak to this issue.

3. The MS in Restorative Dentistry (operative) offered at the University of Michigan is a broadly based two-year program. It is designed to enhance the breadth and depth of fundamental restorative principles and to correlate the oral sciences with clinical practice. Its major objective is the development of teachers and practitioners having broad knowledge and capability in diagnosis, treatment planning, and in the rendering of comprehensive restorative care. Courses are required in restorative dentistry, periodontics, occlusion, oral pathology, dental materials, dental education, and oral biology. Electives often include a seminar in removable prosthetics and orthodontics. Close liaison is maintained with other clinical departments including hospital dentistry. Furthermore, a thesis is required that is most often clinical in nature. The experience of critical literature review, planning and executing a clinical study including the observation and numeration of data, and the subjecting of this data to statistical evaluation provides an intimate encounter with the scientific method for a clinician. Better teaching—better learning results!

4. Dental education, per se, is a major emphasis within this broad concept program.

5. We do not “… preclude the persons who are trained and qualified from occupying faculty positions in operative dentistry education…”, we superimpose additional desirable requisites.

6. We have been fortunate to fill our permanent positions with this caliber of faculty, from this and other schools of dentistry.

7. Dr. Abrams is, I believe, mistaken when he suggests that the consideration of operative dentistry as a “specialty” is “… another step in the fragmentation process of our profession.” Historically, nearly all of the special areas of
dental practice were considered to be "operative dentistry." Over the years these have broken away. My desire, which is shared by many others, is to re-establish the cohesiveness of the elements of dental practice that contribute to excellence in restorative patient treatment. The result should be to unite, not separate. This will benefit patients—and dental education.

Sincerely,
Gerald T Charboneau
Professor and Chairman
Department of Operative Dentistry
The University of Michigan School of Dentistry
Ann Arbor, MI 48109

Dear Sir:

Your editorial in the spring issue is right on the mark. Nearly forty years ago I decided that I would base my practice on operative dentistry; but more importantly, that each and every procedure would have to carry its own weight in proportion to the time that I would be spending on it. By and large, that policy has been successful, and it has included gold foil. Gold foil has earned just as much for me as amalgam. It is interesting that you state "the lower hourly revenue obtained from a direct gold restoration does not encourage many dentists to provide this valuable form of therapy," while one dentist has emphasized several times to me that he can earn thirty to forty dollars an hour more from gold foil than from other procedures.

Perhaps as a general rule, the minimum price that is sustainable over a long period of time most certainly is determined by the cost of production at any given level of quality. Generally, however, a certain portion of the demand for any dentist's services results from less tangible reasons having to do mostly with how high a degree of rapport the dentist establishes with his patient. As the rapport increases, the dentist becomes less and less bound by minimum prices or the cost of his production.

Sincerely,
Frank F Bliss
868 Reservoir Avenue
Cranston, RI 02910

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**Wit and Wisdom**

**Change without Improvement Is Not Progress**

Progress entails change, but change is not progress, it is altering the object, situation or condition.

The greatest evidence of this is factual. The first half of our lives are physical growth and development—these changes are progress. The later half is physical decline and deterioration—these changes are retrogression.

There is an old axiom, "The only thing that is constant is change." We have the ever-whirling wheel of commonplace change, such as day to night, season to season and the natural laws of birth, growth, decline and decay.

The great question about change is: Is it a natural evolutionary change, or is it a man-made, devious, contrived effort for personal gain? The tastemakers in men's styles decree—narrow ties then wide ties, narrow trousers then wide trousers, narrow lapels then wide lapels, narrow-brimmed hats then wide-brimmed. And soon they start all over again. In women's fashions it is fantastic, mini-skirts far above the knee, then maxicoats below the ankles, short hair then long hair, lipstick then no lipstick. All this change is purely commercial bait, having nothing to do with evolution, esthetics or function.

On the other hand we begin with the chariot, then the horse-drawn buggy and all its variations, later we develop the motor-driven vehicle and finally the supersonic jet plane. On water we start with the floating log, then the raft, followed by the canoe, sailboat, steamboat and finally the diesel-motored liner. These are true manifestations of progress, changes generated by new needs, new purposes and new inventions—true developments in the evolutionary process.

In this effervescent era as we are tossed to and fro in the great caldron of change, the great evaluation must be made. Is it true change or contrived change? We believe in true change through normal growth and natural development, for change without improvement is not progress.

From an editorial by Adolph Block in National Sculpture Review, Winter 1969/70
## Recipients of 1979 Student Achievement Awards

### American Academy of Gold Foil Operators

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<thead>
<tr>
<th>Institution</th>
<th>Recipient</th>
</tr>
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<tbody>
<tr>
<td>Baylor College of Dentistry</td>
<td>Michael Lillard</td>
</tr>
<tr>
<td>Boston University</td>
<td>Nicholas Fedorka</td>
</tr>
<tr>
<td>University of California, Los Angeles</td>
<td>Wayne Matsuura</td>
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<td>Allen Franz</td>
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<td>Howard University</td>
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<td>Daniel Hall</td>
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<td>Serge Lebel</td>
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<td>Frederick Lindblom</td>
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<td>Marquette University</td>
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<td>University of Maryland</td>
<td>Leo Trai, Jr</td>
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<td>University of Michigan</td>
<td>Gordon Callison</td>
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<td>University of Minnesota</td>
<td>Chris Lawther</td>
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<td>Carl Profazi</td>
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<td>University of Nebraska</td>
<td>Bradley Asteford</td>
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<td>New Jersey Dental School</td>
<td>Joseph Stilts</td>
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<td>State University of New York at Buffalo</td>
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<td>State University of New York at Stony Brook</td>
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<td>University of Oklahoma</td>
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AN ATLAS OF DENTAL RADIOGRAPHIC ANATOMY

by Myron J Kasie

Published by W B Saunders, 1977. 150 pages. Indexed. $12.50

This small atlas primarily represents a collection of radiographs exceptionally good for teaching and useful for all of the dental profession.

There are 71 enlarged plates of radiographs with many containing more than one radiograph per plate. Each plate is lettered to indicate areas of interest mentioned in the legend to that plate on the preceding page. There is plenty of margin for reader notes. Intraoral radiographs and extraoral radiographs constitute the two main sections of the book. The intraoral section comprises: 1) anatomy of the human maxillary arch, 2) anatomy of the human mandibular arch, 3) intraoral bitewing radiographic anatomy, and 4) anatomy viewed on occlusal radiographs of the maxilla and mandible. Much emphasis is placed on intraoral radiography, possibly because most routine radiographs are intraoral except for panoramic extraoral radiographs.

Because this book is an atlas, there is no
written commentary, only the lettered areas of interest and the legends. It would have been beneficial had the author annotated the plates with more than the simple legend, particularly for the extraoral radiographs.

Most radiographs show normal anatomy or variations. There is no emphasis on pathological conditions, though there are many radiographs with various oral conditions present.

This book is particularly useful to beginning students learning to interpret radiographic films. It is equally useful to dentists and hygienists who would like to review radiographic interpretation and utilization.

Richard C Hagemeyer, RDH
Kent, Washington

RADIOLOGY FOR DENTAL AUXILIARIES

by Herbert H Frommer

This text is a basic introduction to dental radiology for the dental auxiliary. The author presents important fundamentals of dental x-ray technology. He repeatedly stresses clinical excellence within the confines of the safety of the patient and operator.

The nine chapters deal with the following:

1. Basic principles of x-ray generation and image production
2. Introral radiographic technique: bisect­ing the angle method
3. Introral radiographic technique: the parallel­ing method
4. Radiation protection
5. Accessory radiographic techniques
6. The dark room
7. Film mounting and normal radiographic anatomy
8. Radiographic interpretation
9. Patient management and special problems

Three major concerns of this text are: 1) x-ray properties (generation, image production, processing, and radiation protection); 2) radi­ographic techniques (introral and extraoral); and 3) interpretation (normal anatomy and pathological conditions). All of the chapters would be enhanced with classroom amplifica­tion and discussion. The questions at the end of each chapter certainly enable the auxiliary to review the important aspects of each chap­ter; however, many of the questions seem rudimentary, perhaps trite.

The section on special problems, such as gagging, tori, and handicapped patients, is interesting and useful. The list of suggested readings is also helpful for the student desiring more information. The line drawings, illustrations, and photographs are excellent and pertinent. The author could have given the reader more information on automatic processing of films and more information on the quality of the developing machines available.

The text is easy for a dental auxiliary to read and can be very useful in dental offices as well as classrooms.

Richard C Hagemeyer, RDH
Kent, Washington

Press Digest


Infrared thermography was used to measure changes in temperature of skin overlying sites of injection of local anesthetics without vaso­constrictors. Increase of temperature signifies vasodilation and decrease of temperature signifies vasoconstriction. Procaine (Novo­caine) 2%, butanilicaine (Hostacaine) 3%, and lignocaine (Xylocaine) 2%, produced vasodila­tion. Procaine produced the most and ligno­caine the least. Prilocaine (Citanest) 4% was indifferent and mepivacaine (Carbocaine) 3%
produced vasoconstriction. The duration of analgesia of the pulp with these anesthetics ranged from zero with procaine to 17 minutes with mepivacaine.


A study of 1126 patients with oral leukoplakia and 326 patients with oral lichen planus disclosed that 32 lesions could be attributed to electrogalvanism from metallic dental restorations. Five lesions became malignant.


Histology of four pairs of teeth shows that etching enamel for two minutes with 50% phosphoric acid produces no observable changes in the pulp at 24 hours.


Of 175 smooth cervical lesions restored with Aspa after etching the surface but without preparing cavities, 13 were lost within six months. Eight of these restorations were replaced and three were subsequently lost. Retention of the restorations in shallow lesions, less than 1 mm, was not as good as that in deeper lesions. Toothbrushing habits affect the amount of wear.

Correction

In the question to Dear Woody submitted by Dr B Ogman and published in the Summer 1979 number of the journal, volume 4, page 135, the bur used was stated to be No 558; it should have been No 556.

Announcements

NOTICE OF MEETINGS

Academy of Operative Dentistry
Annual Meeting: February 14 and 15, 1980
Hyatt Regency Hotel
Chicago, Illinois

American Academy of Gold Foil Operators
Annual Meeting: October 9 and 10, 1980
Louisiana State University
New Orleans, Louisiana

NEWS OF STUDY CLUBS

Course in Gold Foil Procedures
Seattle, Washington

The Associated Ferrier Study Clubs are planning to offer a two-week course in the summer of 1980 in Seattle. This is the class participation, clinical course that is provided by the Association for its associate members. A limited number of nonmembers of the study clubs can usually be accepted into the class, depending on available facilities.

Anyone who is seriously interested in such a course is invited to indicate his or her interest, as soon as possible, to the Association secretary.

Dr Donald B Deans
3819 NE 45th, #D
Seattle, WA 98105

NEWS OF THE ACADEMIES

American Academy of Gold Foil Operators

The 29th annual meeting was held 17–19 October 1979 at Baylor College of Dentistry and the Hilton Hotel in Dallas, Texas. Clinical operations were demonstrated during the morning of 18 October and the president's reception and banquet followed in the evening. A
highlight of the banquet was the presentation to Ralph A. Boelsche of the first Distinguished Member Award of the academy. The meeting was concluded the next morning after the essays were given. The new officers of the academy are:
Melvin R. Lund, president
Perry W. Dungey, president-elect
Harold Schneppe, vice-president
Jack G. Seymour, secretary-treasurer
Chester J. Gibson, assistant secretary-treasurer
Ronald K. Harris, member of the Executive Council

Woody Rupp (right), president of the Academy of Operative Dentistry, congratulates Mel Lund, incoming president of the Academy of Gold Foil Operators. Harmony between the academies extends even to the ties. (Photograph courtesy of Bill Roberts)

Incoming president Melvin Lund addresses the academy.

Marty Anderson, assisted by Arlene Anderson, prepares a cavity for a class 2 foil in the distal of a first premolar.

President Gibson registers approval as he observes Alan Frum, assisted by Ardle Frum, prepare a class 3 cavity from the lingual.
Aim and Scope
Operative Dentistry publishes articles that advance the practice of operative dentistry. The scope of the journal includes conservation and restoration of teeth; the scientific foundation of operative dental therapy; dental materials; dental education; and the social, political, and economic aspects of dental practice. Review papers and letters also are published.

Publisher
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